Space Weather Technical Forecast

Issued on Sunday, 21 August 2022 at 13:11 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1 peaking 22 into 23 August. R1 risk falling. Chance of Active electron fluence into new week.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has fallen to Low over the past 24 hours, with just one C-class flare, a C2.9 peaking at 21/0459 UTC. This flare was from AR3081 (Hax, alpha) in the northwest. The previously active AR3078 has weakened and now rotated off the western limb of the visible disk. The other two numbered regions on the disk, AR3082 and 3084 appear small and stable, as does an unnumbered NEW region in the northeast.
The arriving eastern solar hemisphere appears much blander than the departing west in terms of the starkness of opposing magnetic polarities in HMIBC imagery. The combination of this quieter face becoming increasingly dominant and the fading of activity from across the disc has led to a notable quietening in the past 24 hours, with the Penticton 10.7cm flux correspondingly falling from 131sfu on Monday 15 August to 102 on Saturday 20 August.

No Earth-directed CMEs were observed in available coronagraph imagery.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured by DSCOVR and ACE at L1, was symptomatic of both a waning fast wind regime from CH14/-, and also a minor CME arrival at L1 at 20/1725 UTC. The speed was predominantly elevated though peaked at 633 km/s at 21/0355 UTC. The associated solar wind density showed a relatively flat trend, mainly in single figures ppcc but peaking at just above 10ppcc with the 20/1735 UTC CME's onset. The interplanetary magnetic field strength (IMF), Bt increased following the CME arrival peaking at 9nT but remained predominantly weak below 8nT, while the north-south component Bz varied between +/-7nT. The phi angle was mostly negative (towards the Sun) with a brief rotation positive following the CMEs arrival.
The net result of the above solar wind measures on provisional geomagnetic activity was a peak of Active Kp 4- in the 20/21-24 UTC interval, else being mainly Quiet to Unsettled.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV), as measured by GOES16, was at Background levels. The high energy electron flux (greater than 2 MeV) slowly increased to a peak of 1740 pfu at 20/1940 UTC, before returning to Normal Background to Moderate levels from 20/2035 UTC.
The 24-hour integrated electron fluence was below the Active threshold on a near-level trend, with an observed value of 5.93e7 integrated pfu at 21/0001 UTC.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be Low to Very Low, with AR3078 departing the disc, with little to compensate on the current facing side or arriving over the eastern solar horizon.

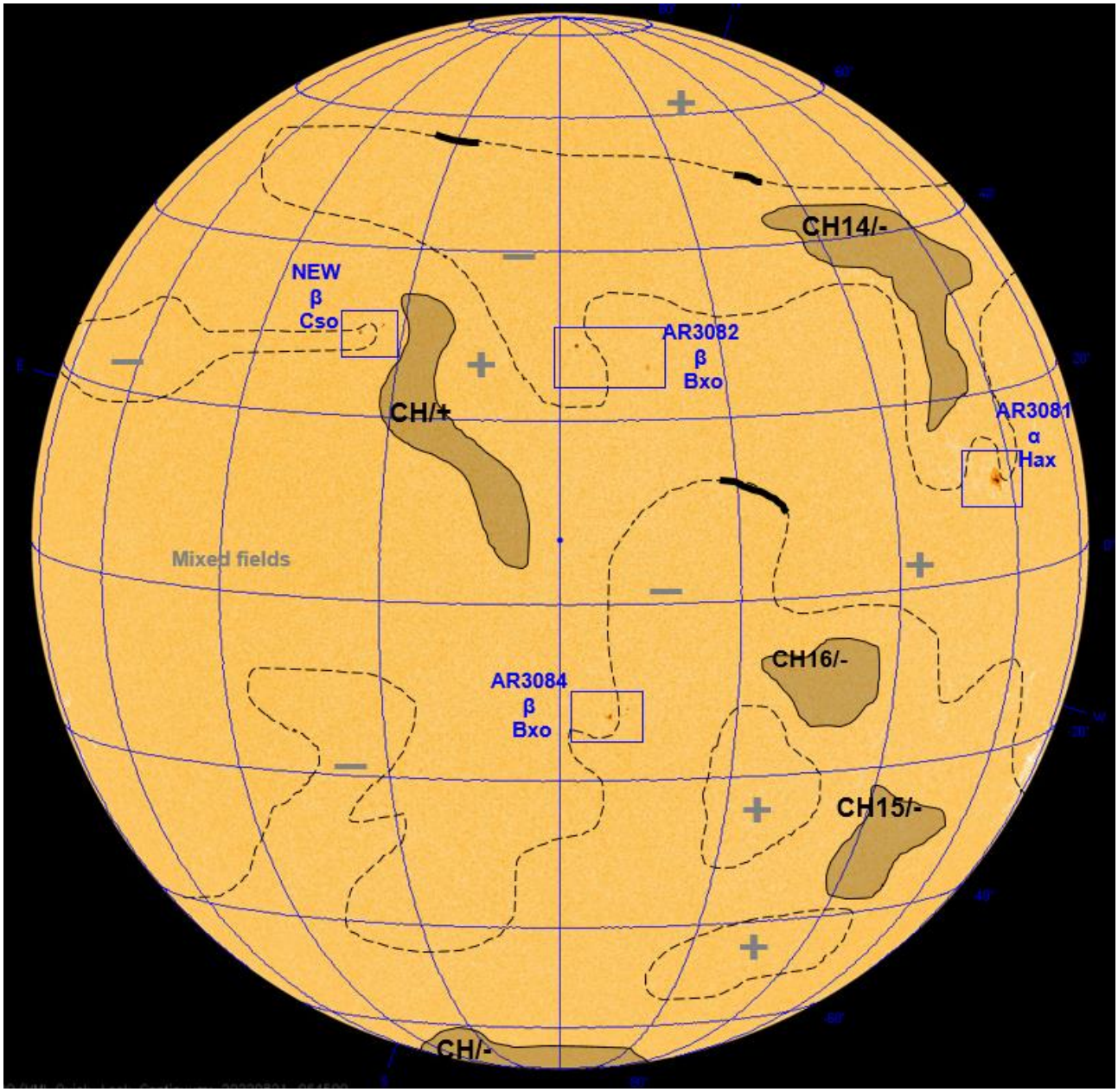
Solar Wind / Geomagnetic Activity: The geomagnetic forecast is low confidence throughout, largely the result of the sheer number of mostly minor CMEs from AR3078, with some cases of glancing incidence possible, now perhaps most likely on day 2 (22 August), with two others having recently arrived (19/1702 UTC and 20/1735 UTC). Otherwise, the CH14 fast wind is expected to continue to gradually ease early on day 2 (22nd Aug), ahead of a second coronal hole fast wind from CH16 perhaps incident on day 3 (23rd Aug).
Geomagnetic activity is expected to be Quiet to Unsettled for much of the period, but with further spells of Active to G1 Minor Storms due to any CME glances, now thought most likely straddling the UTC days 2 and 3 (22 and 23 Aug).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) will most likely remain at Background levels.
High energy electron flux should show an upward tendency in the period, the result of reaction to the fast wind from coronal hole 14, albeit tempered by any CME arrivals, which lower the confidence in the forecast. This may give Active 24 hour fluence, most likely during the first half of the four-day forecast period, prior to geomagnetic activity from a possible CME and coronal hole arriving in succession from later on 22 and through 23 August.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Figure 1. Solar Analysis Valid 21/0700 UTC.



.

Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Geomagnetic Storms:

The geomagnetic forecast is low confidence throughout, due to the number of mostly minor CMEs from AR3078, with amalgamation of these likely and some cases of glancing incidence still possible. The main period of risk is now considered later on day 2, (22nd Aug) into day 3 (23rd Aug), although minor glances prior to this cannot be ruled out.

The current coronal hole fast wind from CH14 is now thought to be in decline along with the minor CME arriving 20/1735UTC. A quieter period of geomagnetic activity should now ensue on day 1 (21st Aug). Consideration then shifts to the forecast CME arrival 22 into 23 August, and from there another coronal hole, CH16. This coronal hole is not a persistent feature on the disc, with most likely arrival on day 3 (23rd August). This forecast is supported by MOSWOC Enlil, which has been verifying well recently, providing moderate confidence in the coronal hole aspect of the forecast.

Geomagnetic activity is expected to be Quiet to Unsettled for much of the period, but with further spells of Active to G1 Minor Storms due to any CME glances, most likely later day 2 (Monday 22 August) into day three, perhaps bolstered by CH16 later on day 3 (23 Aug).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	30	30	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

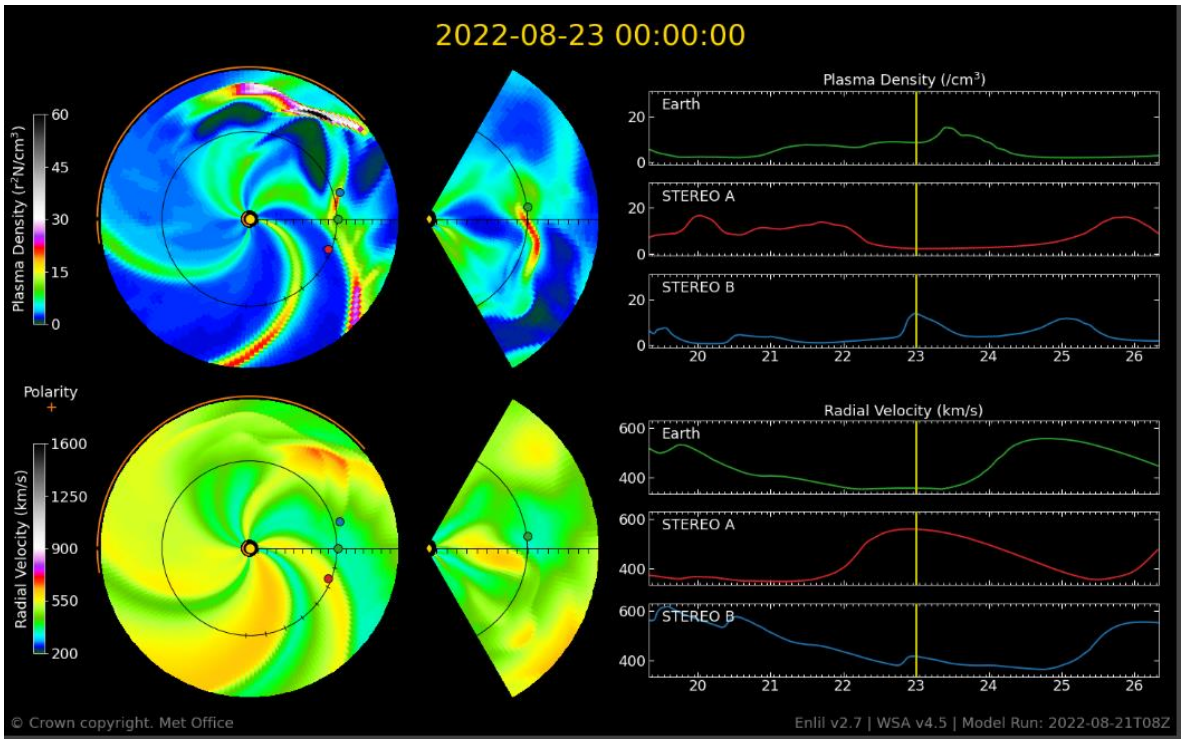
Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
19/0922UTC	Partial	AR3078	40W25S	700km/s	23/0001 UTC +/-12 hours	Probably now preceding CH16 to lesser effect. Volatile arrival time in models perhaps result of complex CME interactions

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Figure 2: MOSWOC Enlil shows a glancing blow from a CME late on the 22nd or early 23rd.



Radio Blackouts - X-Ray Flares:

Solar activity has been strongly tied to AR3078 in recent days, and now this spot group has faded off the western limb of the visible disk, the prospects for further Moderate activity are in decline, with little to succeed it on either the remainder of the front side or over the eastern solar horizon.

The chances of M-class activity are therefore Slight throughout, with a falling tendency.

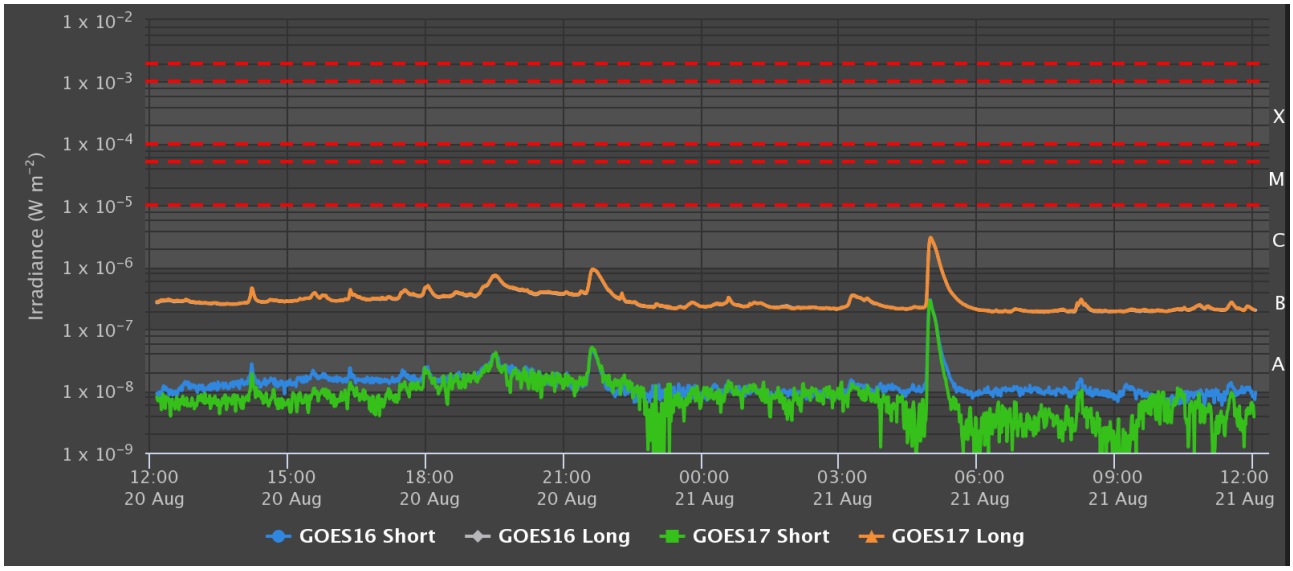
X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	5	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES16 X-Ray flares have declined markedly.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Met Office Space Weather Technical Forecast



Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10 MeV) as measured by GOES-16 is at background, with recent days' very slight enhancements (all comfortably sub-S1) having eased.
There remains a very slight chance of further enhancement due to the location of weakening AR3078 in the southwest, but although this group has produced solar radiation events, they have been very minor (comfortably sub-S1).

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	2	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):

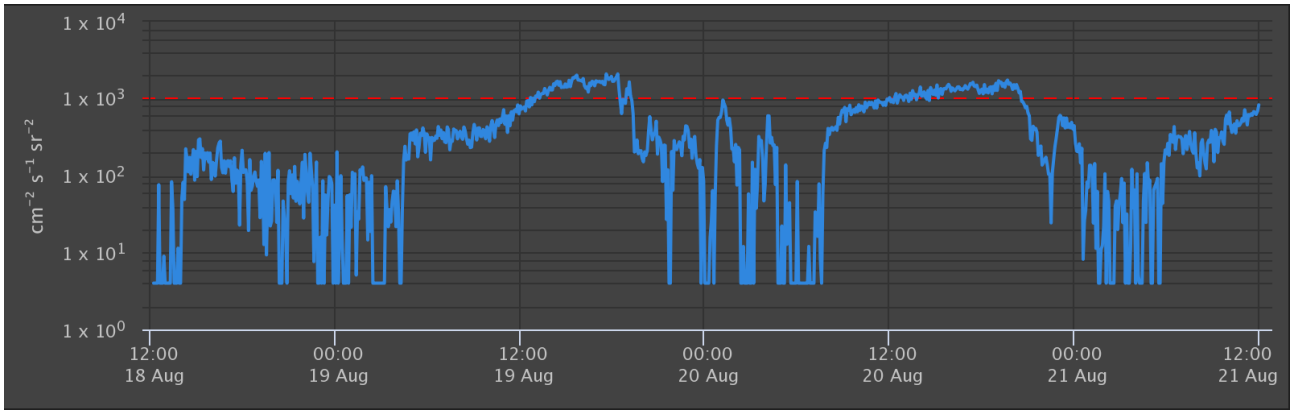
The high energy (greater than 2 MeV) electron flux as observed at GOES-16 has shown a response to both the current fast wind from CH14, but also the successive CMEs, with effects combining to make the electron forecast both volatile and of relatively low confidence.

In the absence of any CMEs, flux levels were expected to rise to be mostly High as the CH14 fast wind eased, however this has been delayed and perhaps dented by a pair of recent CME arrivals. A degree of recovery in values is likely over the remainder of day 1 (21st Aug). A more likely and more lasting reduction in flux may now occur with the arrival of a CME on days 2 into 3 (22nd-23rd Aug), with another coronal hole fast wind from CH16 expected on day 3 (23rd Aug). This second coronal hole is not a persistent feature, and appears visually smaller than CH14, with solar wind speeds and the reaction from electron flux probably of lower magnitude as a result.

Overall, the volatile nature of the flux forecast means that the associated 24-hour fluence is low confidence, but should reach its peak for the period either late on day 1 or early on day 2 (21st/22nd Aug), with levels then rallying for a time, ahead of more consistent declines later in the four days.

GEO Electron Environment	Level ($cm^{-2}\ sr^{-1}\ day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	60	60	30	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: GOES16 ElectronFlux has been reaching High levels near the diurnal maximum.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.